# Promoting Green Consumption in Retail Markets: Behavioural Interventions under Strategic Pricing

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# Promoting Sustainable Consumption

- Increasing recognition of the need to shift consumption to health/climate/animal/biodiversity -friendly alternative
- Retailers play a prominent role in consumption choices
- Especially for food products

## Organic food

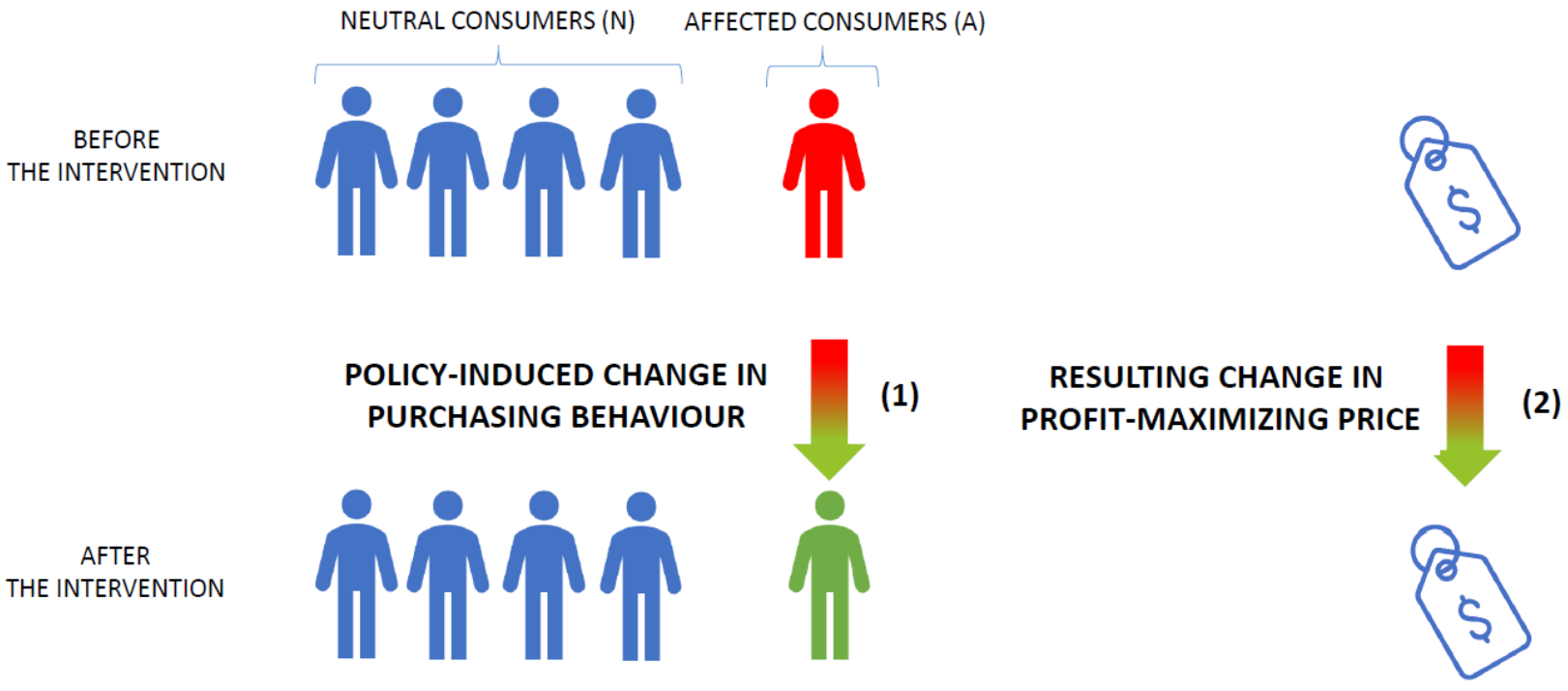
- Ambitious production targets (ex: EU "Farm to Fork")
- Demand-side policies to support the growth of the market
- Key policy objective : increasing the consumption of organic food products

# Behavioural interventions

- Barcode scanner app


- Salient front-of-pack labelling

# What do behavioural interventions really do ?




We should care about the price effect of these interventions !

# Literature

- Large empirical IO literature on price effects of behavioural interventions, in particular for food products (Allais et al. 2015, Dubois 2018, Villas-Boas et al. 2020)
- Theoretical models of demand shifts and mass/niche markets (Johnson and Myatt 2006)
- Boycott, price elasticity and competition (Hendel 2017)

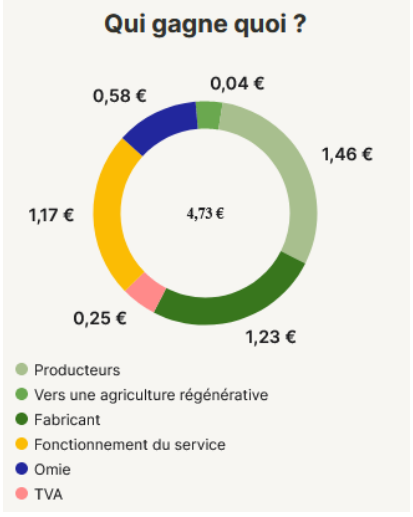
# Quality-focused VS Price-focused behavioural interventions

- Quality-focused interventions make consumers willing to pay more for the green good ("is it the greenest choice?")
- Price-focused interventions rmake consumers more sensitive to prices ("is it worth its price?")
- My main claim : since currents interventions affect mostly environmentally-aware consumers, we should make them more price-focused

# Some examples of price-focused behavioural interventions

## Retail transparency on margins

## Recommended prices


## Product rankings with salient price information

| | | |
|---|---|---|
| Vigean<br>Huile d'olive bio d'Italie<br>Vierge extra - Italie - Bio<br>AVIS DU TESTEUR FICHE PRODUIT | 15,5 /20 | 19,95 €/l |
| Puget<br>Olives de France<br>Vierge extra - France<br>FICHE PRODUIT | 14,9 /20 | 25,16 €/l |

# Outline

## Theory

- Sufficient statistics for the price effect
- Optimal interventions accounting for the price effect

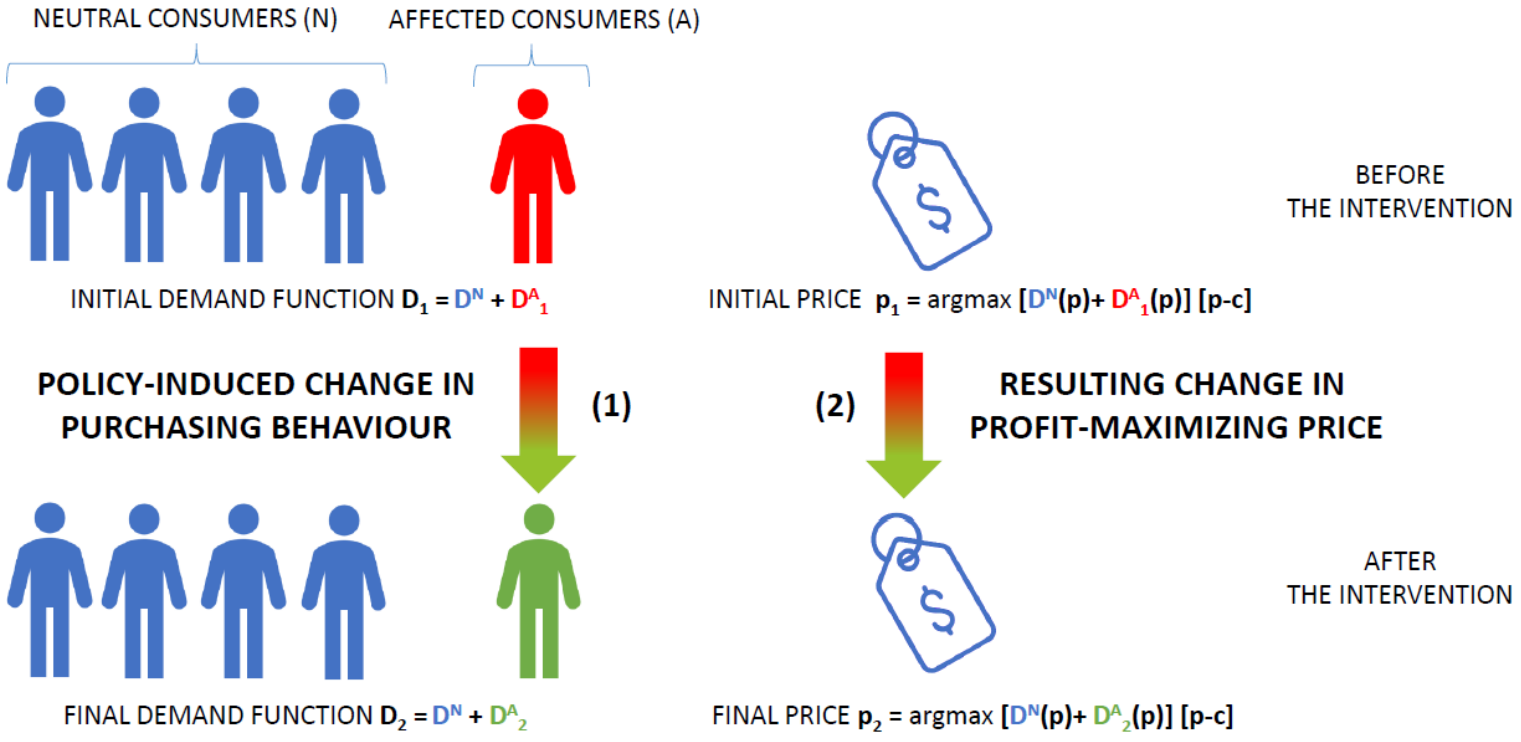
## Empirical analysis

- Egg purchases from a consummer panel
- Structural model calibration

## Policy simulations

- Order of magnitude for reasonable interventions
- Price-focused interventions $>$ quality-focused interventions

# The model




(3)

$$\Delta D = D_2(p_2) - D_1(p_1) = [D^A_2(p_1) - D^A_1(p_1)] + [D^N(p_2) - D^N(p_1) + D^A_2(p_2) - D^A_2(p_1)]$$

***TOTAL CHANGE IN CONSUMPTION***

**BEHAVIOURAL EFFECT** (USED IN POLICY EVALUATIONS)

**PRICE EFFECT** (OFTEN IGNORED IN PRACTICE)

# Sufficient statistics for the price effect

- Main assumption : monopolist with fixed marginal cost $c$, target behaviour independent of $\epsilon$ (i.e $\underline{\Pi}_i^A = \epsilon \times \Pi_i^A$)

$$\Delta p \underset{\epsilon \to 0}{\sim} \frac{\frac{\partial \underline{\Pi}_1^A}{\partial p}(p_1) - \frac{\partial \underline{\Pi}_2^A}{\partial p}(p_1)}{\frac{\partial^2 \Pi^N}{\partial p^2}(p_1)} \times \boldsymbol{\epsilon}$$

- The price elasticity of profit on affected consumers is key !

- Implication : best to target those whose initial profit function slopes upwards

# Optimal behavioural interventions

- Assumptions : monopolist firm with fixed marginal cost $c$, single-peaked profit function $\Pi^N$

## The intervention design problem

$$\text{Maximize } D_2(p_2) = D_2^A(p_2) + D^N(p_2) \text{ over the choice of } D_2^A$$
$$\text{such that } 0 \leq D_2^A(p) \leq \epsilon \text{ for all } p > 0$$
$$\text{and } p_2 = \arg\max_{p>0} \left[ D_2^A(p) + D^N(p) \right] (p - c)$$

Given a small fraction $\epsilon$ of consumers, what should be their demand function $D_2^A$ in order to maximize total green consumption ?

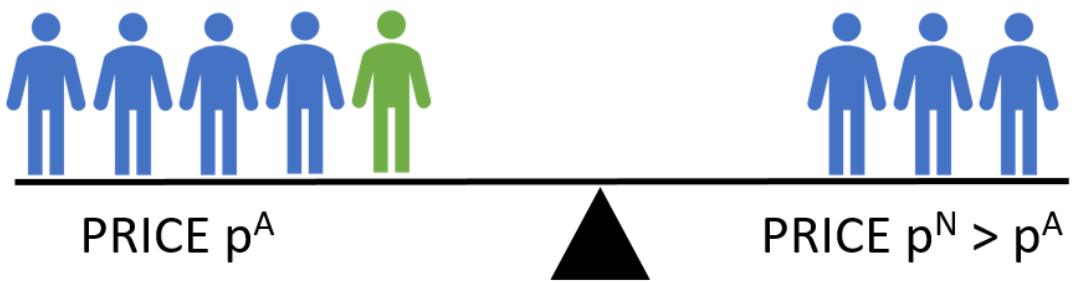
# Cut-off demand functions

**Definition**

The cut-off demand function with threshold price $p_A$ is the function $D(p) = 1_{(-\infty, p_A]}$

Facing a cut-off demand, the firm has two alternatives:

$$[D^N(p^A) + \varepsilon] \times [p^A - c] \quad = \quad D^N(p^N) \times [p^N - c]$$



# Optimal behavioural interventions

- Define $p^A$ as the unique solution on $[c, p_N]$ to

$$\Pi^N(p^A) + \epsilon(p^A - c) = \Pi^N(p^N)$$

**Theorem**

*The purchasing behaviour $D_2^A = 1_{(-\infty, p^A]}$ maximizes $D_2(p_2)$ over all possible choices of $D_2^A$. In this case, we have $p_2 = p^A$ and $D_2(p_2) = D^N(p^A) + \epsilon$*

- Implication : most lab experiments would wrongly reject optimal behavioural interventions

# Sufficient statistics (optimal intervention)

- Assumptions : as previously, plus $\epsilon$ small
- Price variation following an optimal intervention

$$\Delta p^* \underset{\epsilon \to 0}{\sim} \sqrt{\frac{2(p_1 - c)}{\frac{\partial^2 \Pi^N}{\partial p^2}(p_1)}} \times \sqrt{\epsilon}$$

- Implication : Price effect $>>$ Behavioural effect

# The structural model

## Data

- Kantar consumer panel, scanner data, year 2012
- 3000 households, 14 major retailers, 115 products

## Demand-side

- Multinomial logit with random coefficients on both the valuation of the organic label and the price sensitivity
- Control function approach to price endogeneity

## Supply-side

- Nash-Bertrand competition between retailers
- Constant marginal costs

# Estimated demand model

| Variable | Coefficient | Monetary value |
|---|---|---|
| **Label** | | |
| No label | Reference | 0.000€ |
| Free-range label | 1.325* | 0.059€ |
| Organic label | 3.943* | 0.176€ |
| **Price sensitivity** | | |
| Average (income Q1)² | -23.716* | |
| Average (income Q2) | -22.417* | |
| Average (income Q3) | -20.522* | |
| Average(income Q4) | -19.759* | |
| **Variance and covariance** | | |
| Correlation (price sensitivity and organic label) | 1.133* | |

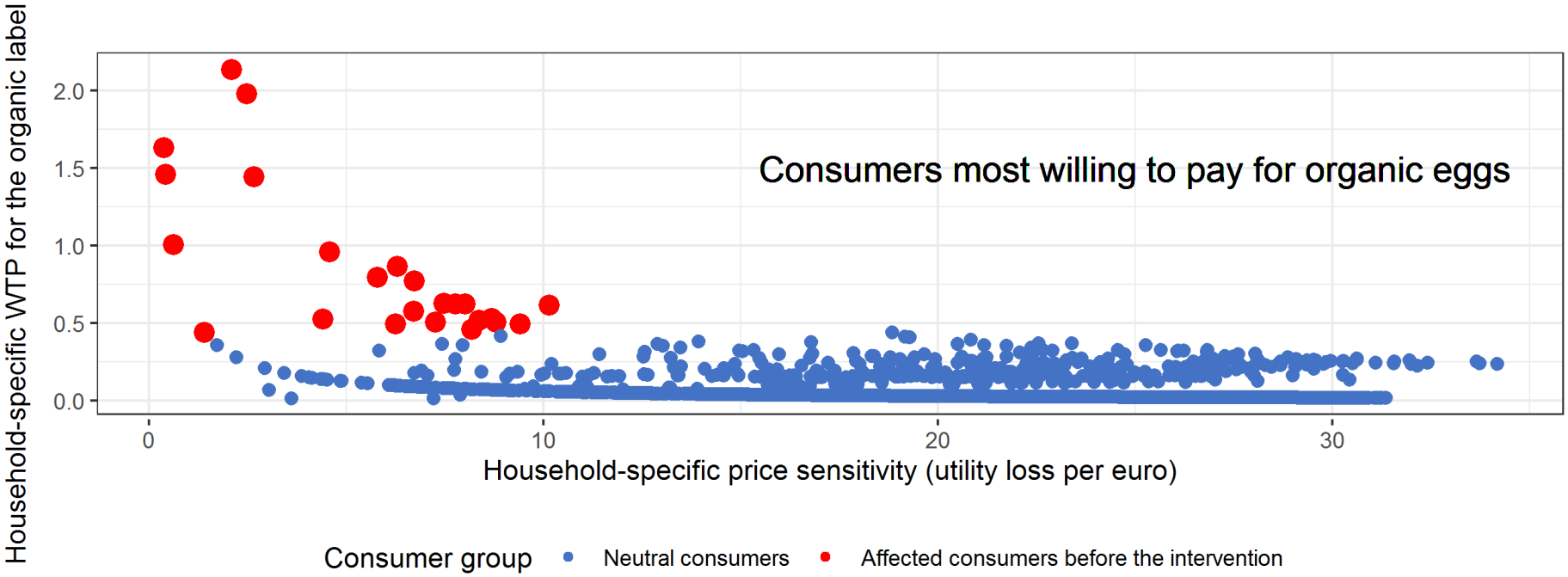
# Calibrated supply model

| Label | Average price | Marginal cost | Marginal benefit |
|---|---|---|---|
| No label | 0.184 | 0.123 | 0.061 |
| Free-range label | 0.291 | 0.215 | 0.076 |
| Organic label | 0.417 | 0.311 | 0.106 |

- The absolute margin is much higher for organic eggs

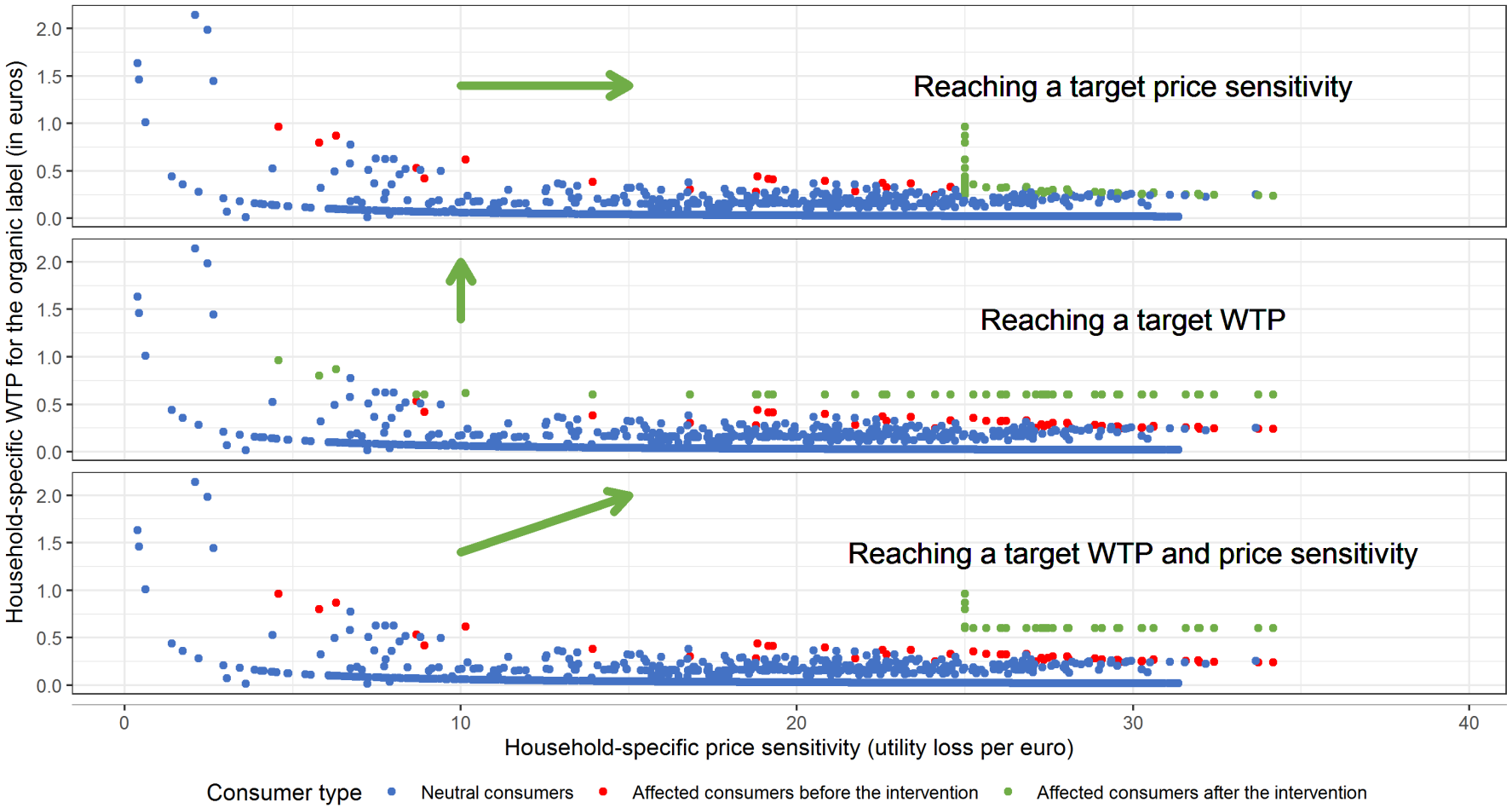
# Household-level estimates

Compute Bayesian mean posterior for the random coefficients:

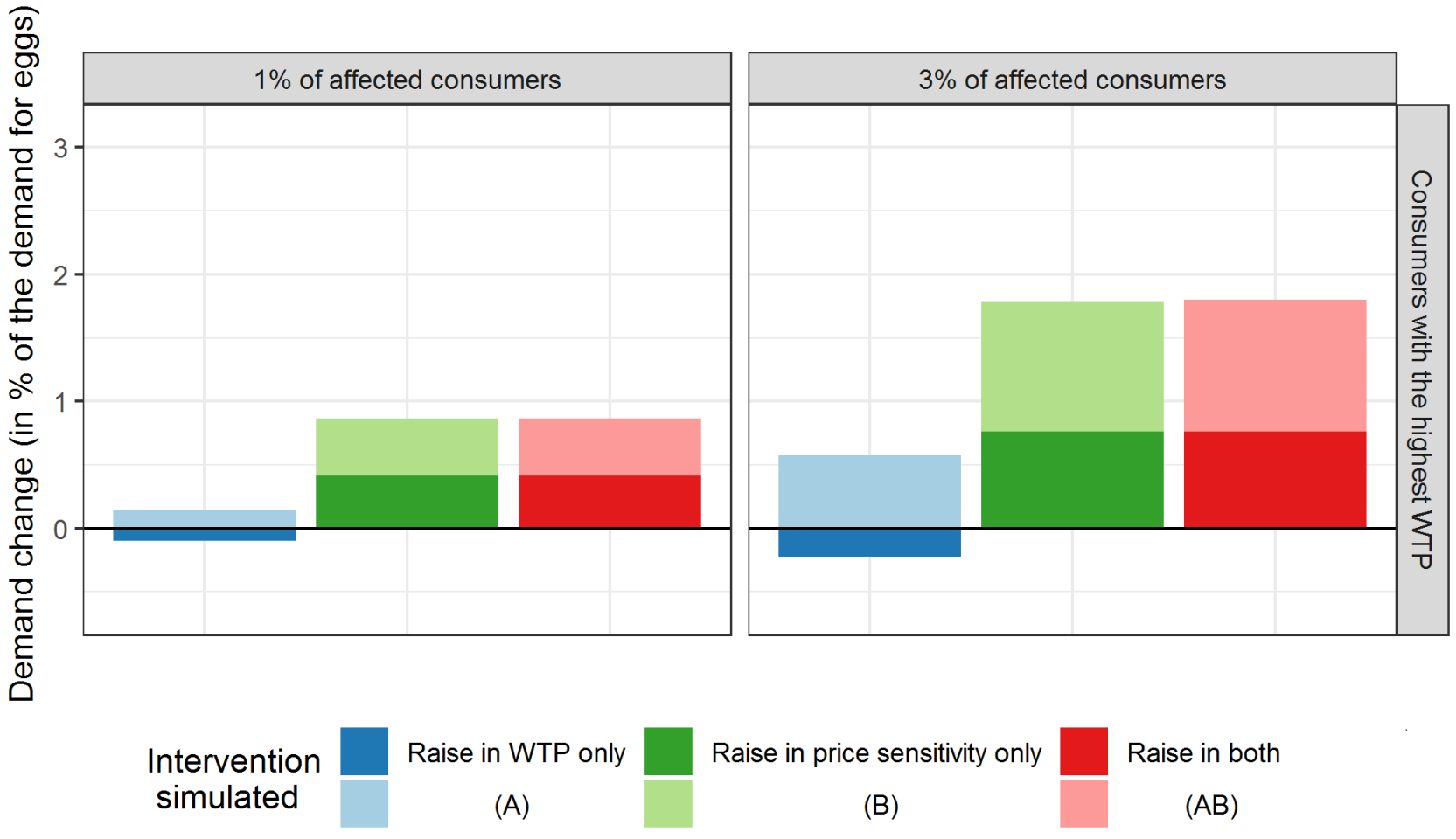



$$\text{WTP}_i = \frac{\text{Value of a basic egg} + \text{Valuation for the organic label}_i}{\text{Price sensivity}_i}$$

# Defining behavioural interventions

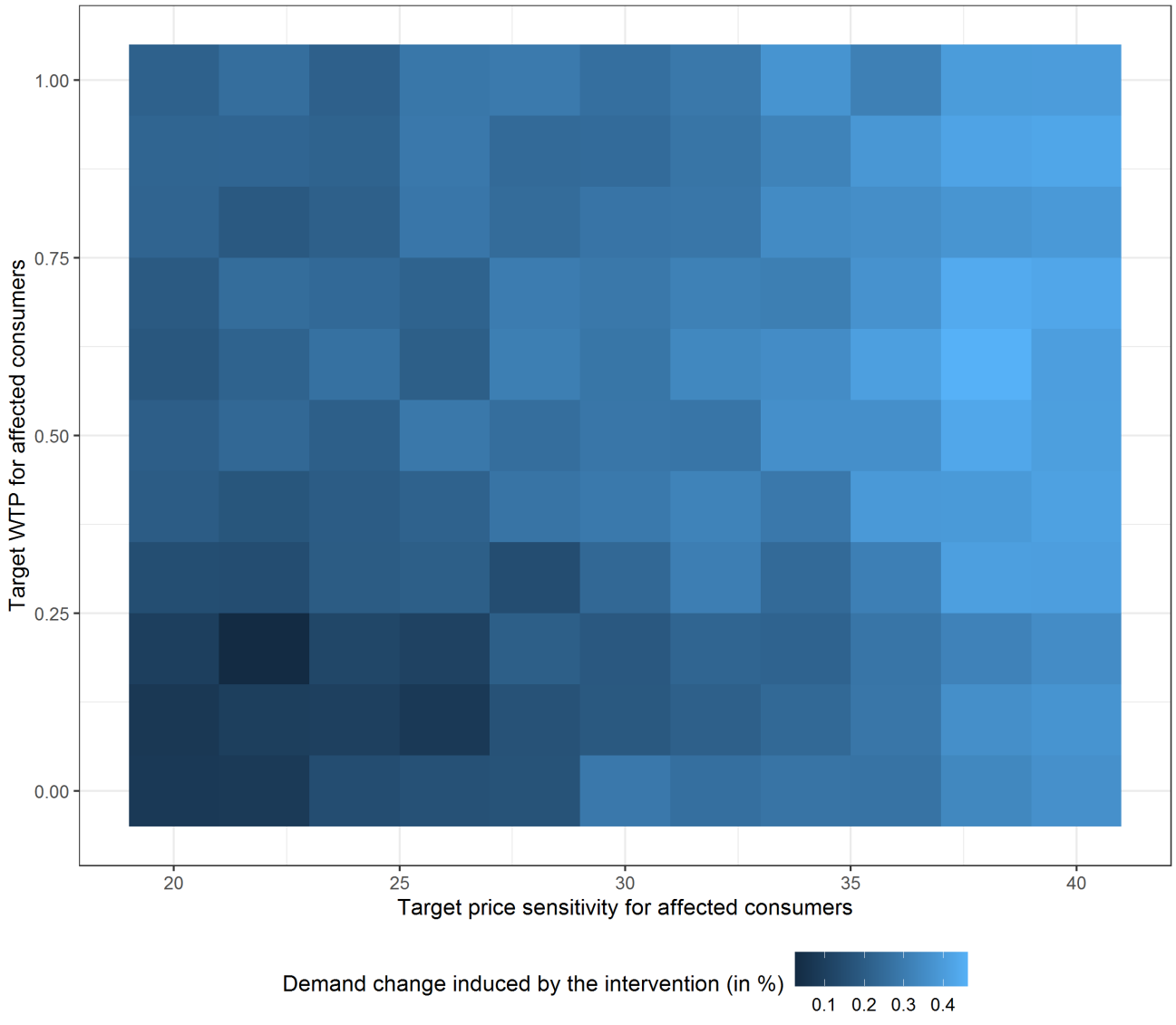


# Magnitude of some selected interventions

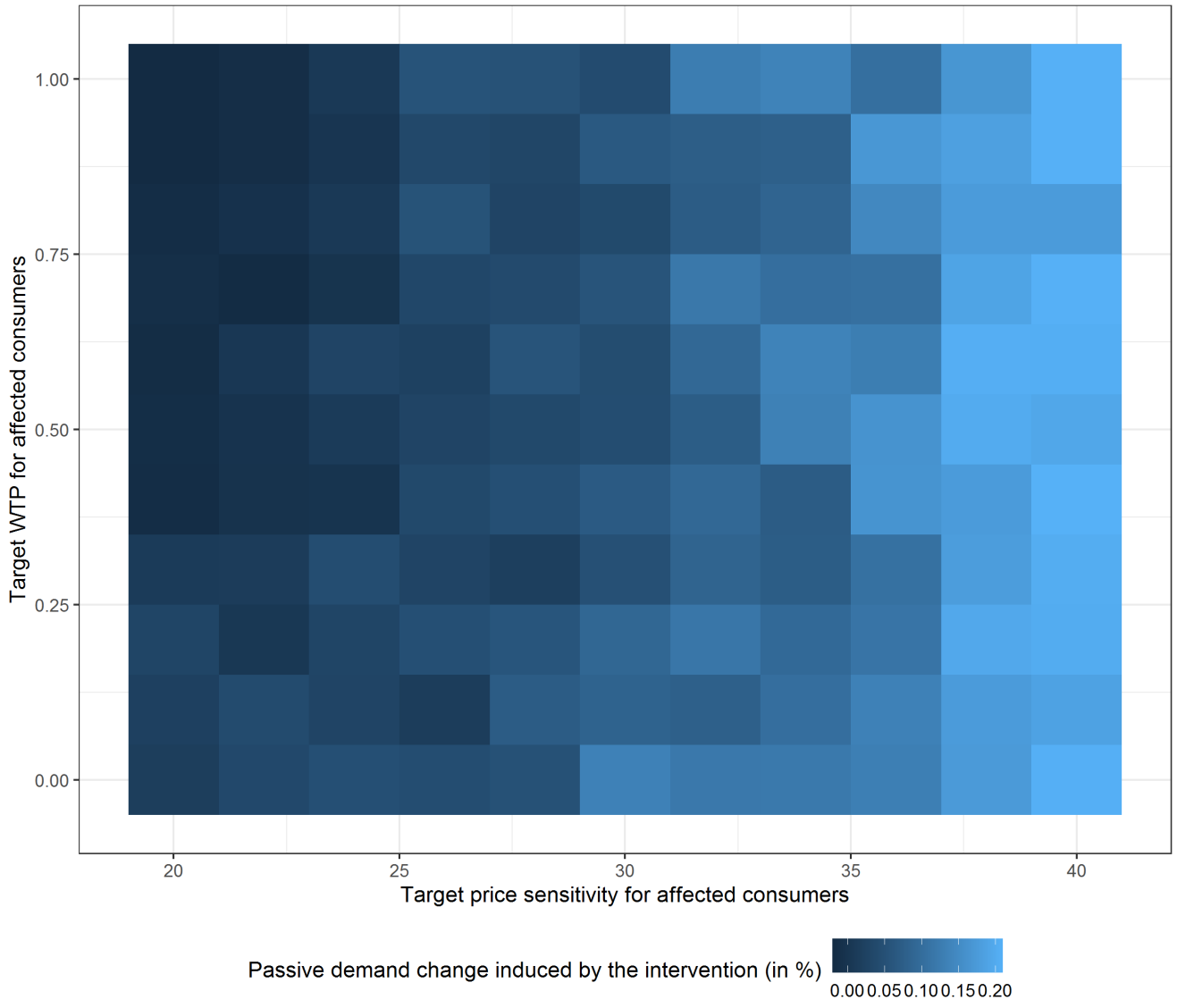



Light (resp. dark) bars show demand change in total (resp. due to unaffected consumers). Bars overlap.

# Exploring the space of behavioural interventions (1/2)



# Exploring the space of behavioural interventions (2/2)

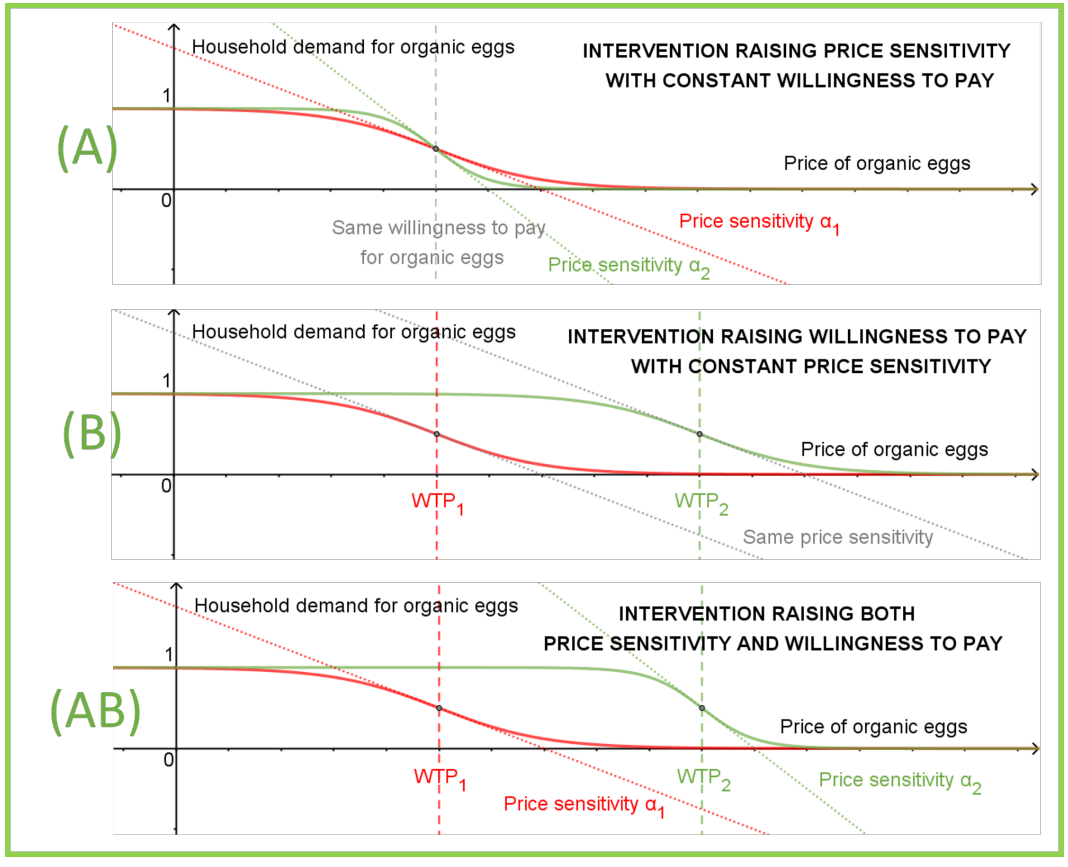


# Conclusion

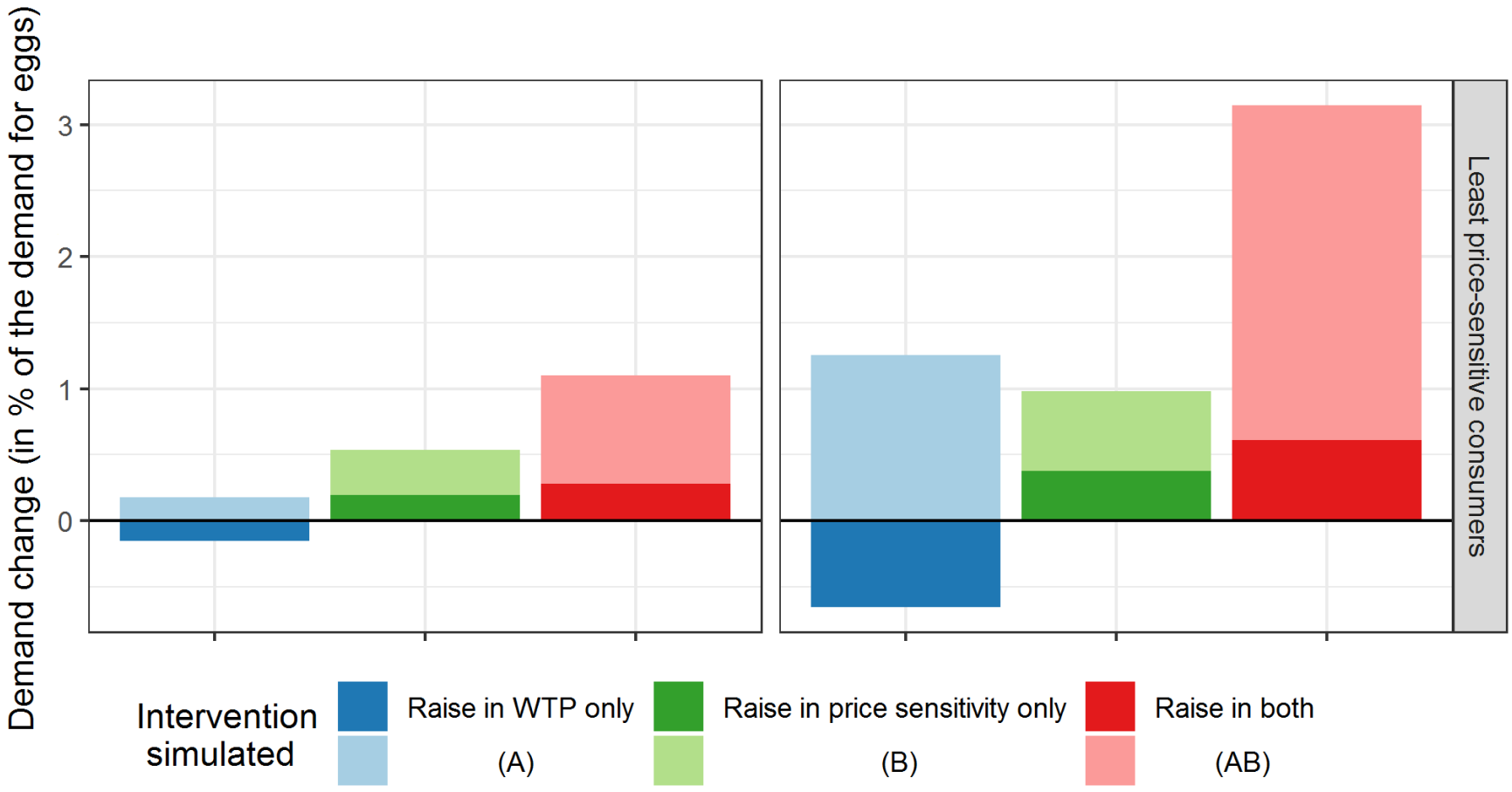
- Behavioural interventions in retail market should mind their price effect.
- When environmentally-aware consumers are the main target of the intervention, put the stress on prices, not just on qualities!
- Implication for climate justice : so-called "green consumers" could easily contribute more than they currently do by asking fair prices for green goods.

Thanks you for your attention

# Complement


(A)
Household demand for organic eggs
INTERVENTION RAISING PRICE SENSITIVITY
WITH CONSTANT WILLINGNESS TO PAY
1
0
Price of organic eggs
Same willingness to pay
for organic eggs
Price sensitivity $\alpha_1$
Price sensitivity $\alpha_2$
(B)
Household demand for organic eggs
INTERVENTION RAISING WILLINGNESS TO PAY
WITH CONSTANT PRICE SENSITIVITY
1
0
Price of organic eggs
$WTP_1$
$WTP_2$
Same price sensitivity
(AB)
Household demand for organic eggs
INTERVENTION RAISING BOTH
PRICE SENSITIVITY AND WILLINGNESS TO PAY
1
0
Price of organic eggs
$WTP_1$
$WTP_2$
Price sensitivity $\alpha_1$
Price sensitivity $\alpha_2$

# Magnitude of selected interventions (other)




Light (resp. dark) bars show demand change in total (resp. due to unaffected consumers). Bars overlap.

# Full calibrated model

| Category | Average price | Marginal cost | Marginal benefit |
|---|---|---|---|
| Cross-product average | 0.272 | 0.197 | 0.076 |
| **Label** | | | |
| No label | 0.184 | 0.123 | 0.061 |
| Free-range label | 0.291 | 0.215 | 0.076 |
| Organic label | 0.417 | 0.311 | 0.106 |
| **Simplified brand** | | | |
| Low-range own brand | 0.148 | 0.090 | 0.058 |
| Medium-range own brand | 0.228 | 0.164 | 0.064 |
| Top-range own brand | 0.273 | 0.193 | 0.080 |
| National brand | 0.333 | 0.247 | 0.087 |
| **Format** | | | |
| Hypermarkets | 0.252 | 0.180 | 0.072 |
| Supermarkets | 0.278 | 0.200 | 0.077 |
| Convenience stores | 0.302 | 0.221 | 0.081 |
| Junior department stores | 0.332 | 0.249 | 0.083 |

*Note:* Prices, costs and benefits are given in euros